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Lecture – 28
Sustainable Manufacturing-II

Welcome friends, in our last session we were discussing about sustainable manufacturing, we discuss that it is very important for manufacturers now to address the environmental concern and it is not simply for the legal purpose, we also discussed that it is important to have competitiveness. Nowadays, customers are looking those products which are coming from environmental friendly processes.

And therefore, if you are a sustainable manufacturing organisation, if you are following the principles of lean manufacturing, these are going to help you in getting competitiveness and therefore, this sustainable manufacturing is not considered simply an exercise to reduce waste which are contributing to the environmental hazards, it is not considered to be an exercise of cost cutting, rather you can consider this exercise as an exercise for getting more competitiveness, as an exercise to identify the new customers.

And then, you will have higher revenues, so what I am requesting that we need to have a complete change in perception, the most of us believe that whenever we have to comply some kind of environmental issues so, we say oh, oh, this is a new problem so, we immediately have this kind of reaction that it is a problem but I am saying that it is an opportunity that opportunity will help you to get more competitiveness.

And we also discuss that how these concepts in a sequence are matching with each other, you are becoming a lean organisation, from lean organisation you are entering into the agile manufacturing where you are able to understand the changing customer requirement and then you are entering into the sustainable manufacturing where your manufacturing is also taking into account the environmental issues.

We discussed that how our seven traditional waste are creating different types of negative environmental impact and we also discuss that what are the different ways, possibilities or you can say strategies through which you can implement these sustainable manufacturing, continuing the same discussion in this particular session, we will discuss some of the key terminologies which are very, very important for us to know with respect to sustainable manufacturing.

Because whenever we talk of sustainable manufacturing, people starts speaking some specific terms so, this session will help us in understanding the meaning of those specific terms which are used in sustainable manufacturing literature.

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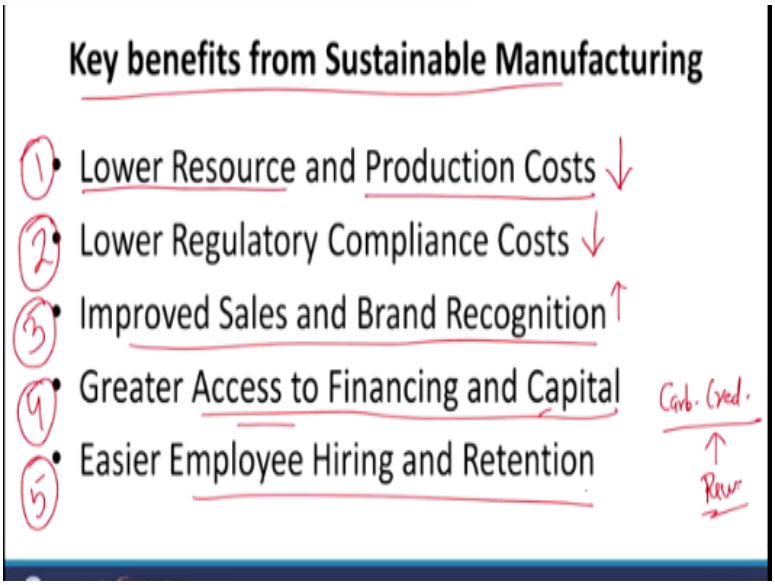

Now, just to have a quick recap of the previous session, what are the key benefits we can achieve by following the sustainable manufacturing practices, now whenever we were discussing that what are the negative environmental impact of the traditional waste so, in that discussion if you recall, many a times we discussed that because of over production, because of inventory because of defects you are using more resources in terms of the material, in terms of energy.

So, if you are having the sustainable manufacturing, your uses of resources will lower down, you will require less raw material, you will require less space, you will require less energy and therefore, your cost of protection will also go down, so that is the direct benefit of green manufacturing practices and therefore, this is one thing because in our previous session; if you

recall we have discussed that you are having a long term objective for the sustainable manufacturing.

The objectives of sustainability can be achieved in long term but this type of benefit is possible to see in the short term also, which will encourage you to follow the principles of sustainable manufacturing, so that is the first direct benefit of sustainable manufacturing. The second is when you are already following the principles of sustainable manufacturing, the cost of complying the legal requirements will also go down.

If you are; it is like that you are driving a four wheeler and at the same time, you are carrying a license with you, if you are driving a four wheeler, you are only driving because you are carrying a driving licence with you so, whenever some traffic police person checks you, you can show the driving licence and there is zero cost almost for that compliance but if you are not having a driving licence and you are still driving a vehicle.

Because you can and now somebody checks you, some police personal checks you then, you have to pay a very heavy fine for violating the law, so therefore the cost of complying the law increases, if you are not following the sustainable manufacturing principles because then you have to pay different types of fines, penalties etc., so that costs obviously we very, very less, if you already in the beginning goes for green manufacturing activities.

Then the third benefit which we discussed in our previous session also that you will have improved sales and brand recognition, as I was giving the example of ITC, so that is an example that how company is looking for having its green image, there is a tough competition among the automobile companies but some of the automobile companies have used this way of promoting their products that if you are purchasing X brand or Y brand, you are purchasing a green vehicle.

The vehicle has been made using a sustainable manufacturing process; green process without damaging the environment, so therefore you will get the mileage in the eyes of customers also, then another issue is greater access to financing and capital, when you are having the sustainable

manufacturing practices, you can earn carbon credits and these carbon credits can help you in getting or accessing additional finance for your business.

These can be the additional source of revenue also, so that is also a very unique advantage of sustainable manufacturing, when you say that because of my manufacturing activities, some other company is creating so much of pollution, I am helping the planet by reducing the impact, I am conserving the planet by my activities, if I am conserving the planet, you are entitled to get the carbon credits.

And then you can do some kind of training of those carbon credits, you can encash your carbon credits and that all is the accessibility to do greater financing and capital, then another benefit of sustainable manufacturing is easier employee hiring and retention, if you are having a pollution free environment inside your plant so, people will love to work in your organisation but if environment is having lot of hazardous gases, there are issues with respect to safety of employees.

There is lot of noise, there are another unhealthy conditions within your plant so, people will not love to work in your plant so, if you are following green manufacturing obviously, when it is environmental friendly manufacturing, it is people friendly manufacturing also so, people will love to work, they will live in your organisation for the longer duration and therefore easy employee hiring and retention possible.

So, all these are the direct benefits of sustainable manufacturing and therefore, those intelligent manufacturers, those who understand the benefits directly they are now moving into the green manufacturing and sustainable manufacturing and through that they are trying to develop competitiveness for their organisation. Now, coming to some key terms; some very specific terms, which we use in context of sustainable manufacturing.

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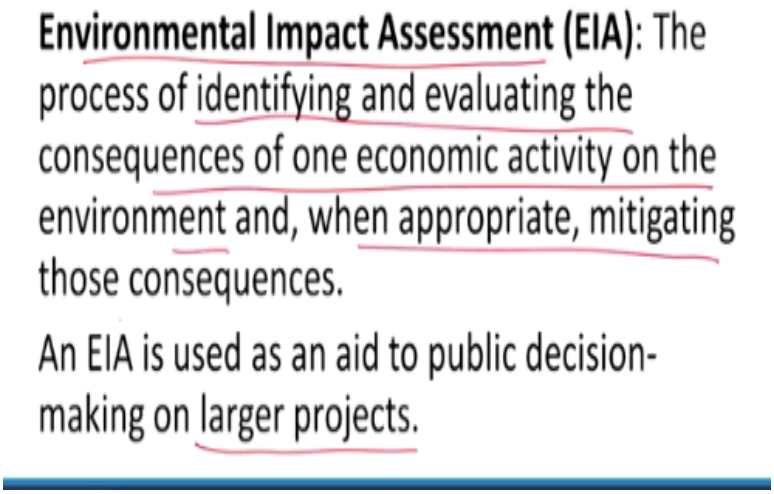

One of them is an environmental impact assessment, this is the very popular term which is normally used in a big projects, so any large project you are going to have in that case, environmental impact assessment is a kind of a prerequisite and what we do is the process of identifying and evaluating the consequences of one economic activity on the environment and on when appropriate mitigating all these consequences.

That means, if I am going to build let us say a dam in some part of Uttarakhand, so what will be the consequences of building that dam on the environment so, the complete study is known as environmental impact assessment, there may be different types of economic benefits, there may be another kind of social benefits but how that project is going to impact the environment that is the component of an environmental impact assessment.

And this is becoming very important nowadays, because people have become more aware, there are a lot of sensitivity about the environment issues and therefore, for any big project this environment concern is becoming very, very serious in India also, we have seen that people are very crazy about large hydro projects, they are also crazy about various kind of nuclear plants, so people understand that sometime these things may negatively impact their environment.

So, they warned that these things should not come into the area but otherwise also, even if you are going to have a manufacturing plant, you should go for environmental impact assessment

before establishing a particular plant project facility etc., so this is very often you hear that whether EIA study has been undertaken or not undertaken. Presently, to the best of my knowledge, any new project cannot be sanctioned without proper EIA study.

This also offers us a career opportunity that young engineers, young managers, they can become an expert of EIA studies, so you can be a third party EIA evaluator, EIA project prepare that will help companies or you can give consultancy to the organisations, if some organisation is going to have some kind of EIA evaluation, so that is one type of definition.

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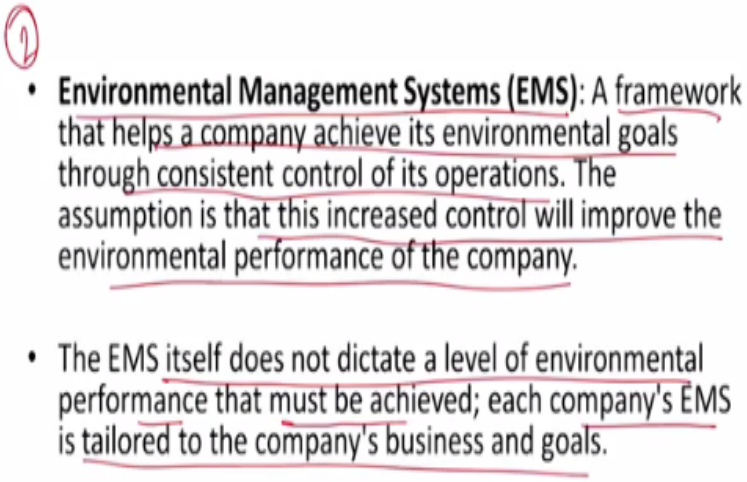

Then another important definition is environmental management system; EMS, now EMS is like a quality management systems we all know that we have in our organisations similarly, you also have environmental management system that what type of environmental system or the practices you are following, so this is a framework that helps a company achieve its environmental goals through consistent control of its operation.

So, as we try to achieve higher quality with the help of quality management system similarly, with the help of this EMS framework a company achieves its environment goal that we; for an example, what type of environmental goal may be there that in the discharge of my gaseous elements, the pm2 label should be less than this so, this type of environmental goal can be

achieved only when you have a proper framework and that framework is known as an environmental management system.

The assumption is that this increased control will improve the environmental performance of the company, when you have everything quantified, when everything is in the transparent, when it is part of a framework, this will help in the organisation this will improve the organisation, their performance with respect to environment. The EMS itself does not dictate a level of environmental performance that must be achieved.

So, as this is purely your own choice that what type of performance you are going to have for your company, as such there is no standard set in EMS, you need to develop your own framework, you need to decide that work level of objective you want to achieve, what is your target for gaseous discharges, what is your target for liquid discharges, what is your target for other kind of reprocessing activities.

So, you decide your own target based on your business, based on your goals etc., developing a framework for that is known as EMS, so like our QMS, where we have ISO systems, here also we will see that we have ISO systems which is basically the conversion of EMS into a kind of SOP; the standard operating process need to follow in the organisation.

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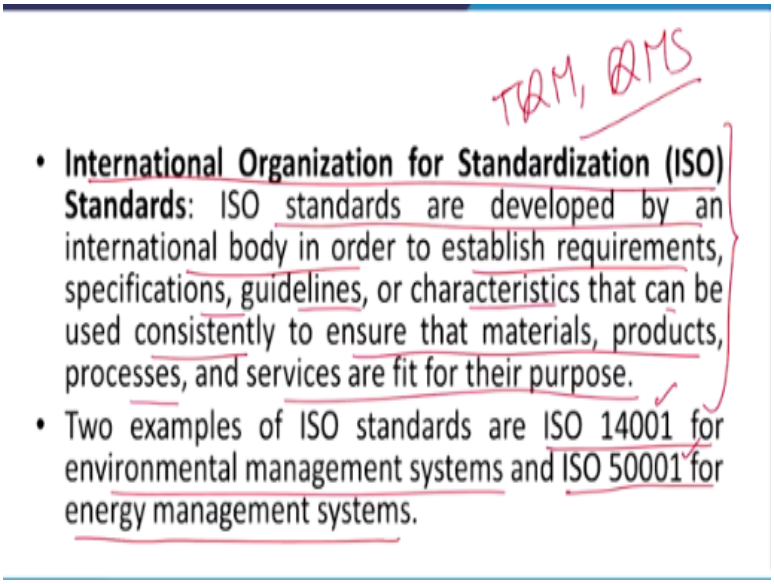

So, this is like following how that framework with the help of ISO system and this ISO standard are developed by international body in order to establish requirements, specification, guidelines, characteristics that can be used consistently to ensure that materials, products, process and services are fit for their purpose. We have discussed this ISO in line of either TQM or QMS; quality management systems.

But ISO's are also applicable, they are actually developing, they are giving you a guideline that how to develop a framework and values in that framework you have to fill on your own so, like a ISO 14001 that is for our environmental management system, we just discussed and another ISO is 50,001 that is for energy management system, both these are applicable for sustainable manufacturing green manufactory.

If you 14,001, it means you are following some kind of environment management in your organisation, if you are having 50,001, you along with environment, you are also following this energy management system, so that is the be framework and you need to give values that if I am having a 50,001 system in my organisation that how much solar energy I am going to produce and then what I am going to do for that, how I am going to monitor whether in my total energy consumption, this much percentage is coming from solar or not.

So, these kinds of things, values whether I decide 1% or I decide 50% that is not important but even if I have decided that 1% of my entire energy will come from solar, what type of systems I have develop for that and how I am controlling that every day, every time, every second, whatever is my total energy consumption, 1% of that is coming from the solar, so that is actually, the purpose of these kind of standard frameworks.

And these are the 2 very popular frameworks, many organisations are now trying to get the certifications and there are audit agencies which are available which help you which provide consultancy as well as then finally they do audit for you and give this kind of certificates and when you have the certificates, you can use these certificates for getting your carbon credits also.

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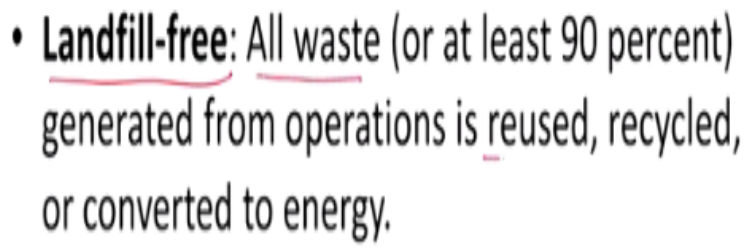

Then, another important terminology is the land fill free, now what does it mean? That the waste which we are generating, the industrial waste or the municipal solid waste, most of the time that waste is used is for land filling because you do not have any other use of that waste, so that is a very interesting concept that the waste is completely reused, recycled or converted into energy. A waste is completely used in these 3 things; either it is reused, recycled.

Or at least 90% of the waste which have been generated that is reused, recycled or converted to energy then we say that it is land fill free, otherwise if it is not possible to reuse, if it is not possible to recycle, if the waste is not converted into energy, then the only alternate available to you is you go for land fill, so that is important thing that if we develop our processes in such a manner that we produced only land fill free waste, then you will have a very sustainable manufacturing organisation.

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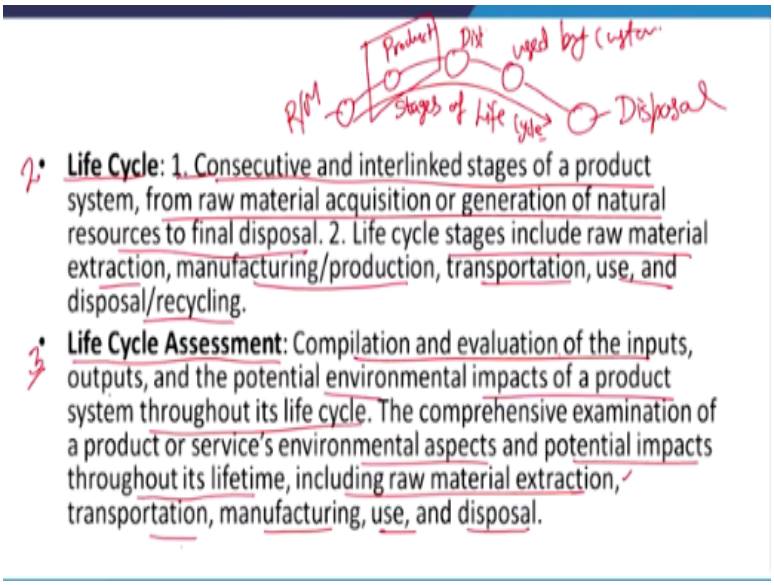

Then, another concept which is a very interesting in the light of this sustainable manufacturing discussion that is the concept of life cycle, whenever we talk of a manufacturing in green terms or sustainable or a smart manufacturing, we immediately talk of life cycle assessment. Now, what is it a life-cycle first? Now, life cycle has 2 important points to make; one is consecutive and interlinked stages of a product from raw material acquisition to generation of natural resources to final disposal.

Now, from the original raw material to the final disposal of the product that is actually the entire cycles, so there are various stages; intermediate stages where you are adding value and right from this raw material stage, the product is being made, it is distributed, used by customer and finally disposal, so that is the life-cycle, that is the complete life-cycle of a product that from the raw material to actually the disposal of those products.

The life-cycle stages include raw material extraction, manufacturing production, transportation, use and disposal oblique recycling, so all these are the various stages of life cycle, depending upon product to product, there may be more or less stages because like, if I am talking of a service, in that service the stages are much less because customer immediately comes into the contact of the service provider and immediately, the services consumed.

And there is no less of a disposal but since in developing the service, in providing the service also, there may be uses of lot of equipments, tools, supporting material etc., so how that particular products are consumed right from the stage of raw material extraction to the final disposal that is the life-cycle of the service component. The second important definition is the life-cycle assessments, so this was the second; this is another with respect to land fill free.

So, now this definition says that compilation and evaluation of the inputs, outputs and the potential environmental impact of a product throughout its life-cycle, now we have just seen that there are various stages in the life of a product. Now, it is possible that the negative impact of that product is more during the extraction stage and during the distribution or consumer when it is using or when it is being disposed, the negative impact is less.

Many a times, when we are discussing the sustainable manufacturing, we are only concerned during this production stage but when we are talking of life-cycle assessment, it is going to have the entire negative impact right from the raw material extraction to the disposal stage, so that is the in totality, a much wider concept of sustainability. The comprehensive examination of a product or service environmental aspects and potential impacts throughout its lifetime including raw material extraction, transportation, manufacturing, use and disposal.

For an example, you may say that I am producing how it is going to have some kind of interesting discussion, I am producing a car which is produced using a very efficient green manufacturing process, so during the manufacturing of that car, I am following the principles of green manufacturing religiously, I am doing the minimum negative impact to the environment but the design of the car is not so good.

And when the car goes in the hands of the customer, the fuel efficiency of car is very low, so for driving 5 kms, it consumes let us say 10 kms of petrol and because when I am driving 5 kms, 10 litre of petrol is being consumed, it is totally creating a negative impact on the environment so, if I am having a shorter vision of green manufacturing, I am only concerned with the production systems which is happening inside the plant.

But when I am going for the life-cycle assessment, I will also see that the when this product will go into use, then at that time also, it is an efficient product or not, so taking 10 litres of petrol for driving 5 km is creating all kinds of negative things which I am enjoyed during the manufacturing and therefore, it will neutralises my environmental manufacturing efforts, so nowadays it is important that at all stages of the product, whether it is from the extraction to the disposal, you should have a positive impact on the environment.

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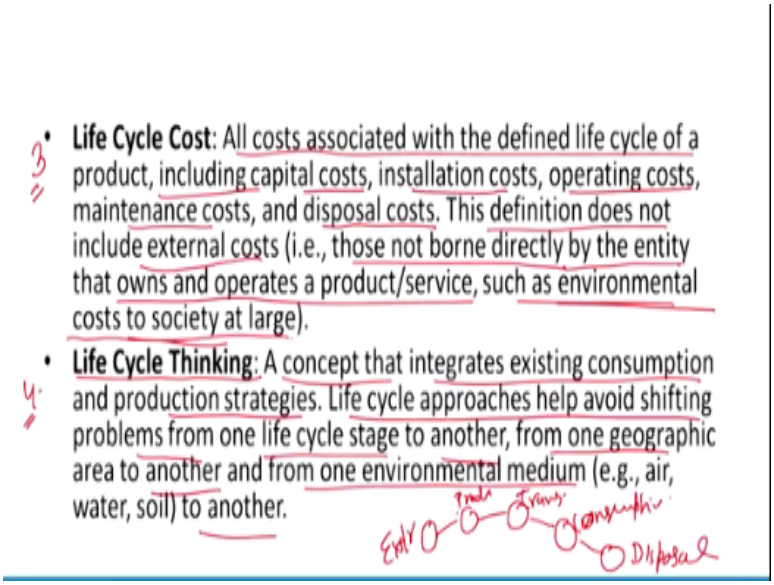

Then, on the basis of this life-cycle discussion, we have another important thing that is in line that is life-cycle costing, now the life-cycle costing because you are passing through various stages from the extraction to disposal so, in this case all cost associated with the defined life-cycle of a product including capital cost, installation cost, operating cost, maintenance cost and disposal cost.

So, at different stage of the product, you will have different types of cost right from the capital to the disposal cost, all these costs are included to determine the life-cycle cost, so that is again a very interesting concept, there are still lot of research going on in the process of evaluation of life-cycle cost, we do not have so much standardisation about calculation of life-cycle cost but as the concern for environment is increasing, I am sure that people will come with more robust methodology to determine the life-cycle cost.

This definition of life-cycle cost we just discuss, does not include external cost, like those are borne; not borne directly by the entity that owns and operates a products and services such as environmental cost to society at large. For an example, we had a very ambitious car by Tata's that is Tata Nano and we used to say that it was a car for poor people in the country and the cost will also around 1 lakh, when it was introduced into the market.

Now, we saw that car only for 1 lakh prospective but when the car is moving on the road, when the car was produced, when the car is transported from the manufacturing location to the other locations then, lot of negative environmental impact was also done, it is not with respect to nano only, it is with respect to any car but we never include that if a car is going to run 10 years on the road and in that 10 year period, how many kilometres will it run, how much fuel it is going to consume.

And for consumption of that fuel, how much discharge it will make to the environment and because of that negative impact of that discharge, how much cost of environmental issues you need to add into that, that we have not included and there are people who are trying to include all those kind of cost also into the cost of the product, so far which life-cycle cost we say that we are not including these kind of negative environmental cost which society has to bear.

But in true sense, if I am going to I want to calculate this life-cycle cost, I should take into account these things also, then another is life-cycle thinking; that is also the concept of holistic way of doing the business, this is a concept that integrates existing consumption and production strategies and what it says that life-cycle approach is help avoid shifting problems from one life-cycle stage to another, from one geographic area to another and from one environmental medium to another.

Many a times what happens that we have a raw material, then production, then distribution, then consumption and then finally disposal, so now in this whenever there is a negative issue because I am in Europe and my production factory is in Europe so, what I will try to do that I will try to shift this location to some other country where there are you can say some relaxed conditions for the environment.

If we follow this kind of approach, this is not in line with the life-cycle thinking, in the life-cycle thinking, if I am taking the responsibility on my own and I am not going to shift these responsibilities to other stages, to other geographical areas or to somebody else, like if today, in India, there are let us say, very strong norms for discharging any kind of things in river Ganga, so let us not discharge in river Ganga, let us discharge to some other tributaries of river Ganga.

If you have this kind of thinking, it is against the concept of sustainable manufacturing and particularly, life-cycle thinking so, neither you can shift from one medium to another medium nor from one stage to another stage, nor from one geographical area to another geographical area, so that all is about the life-cycle way of thinking and life-cycle cost, life-cycle assessment and that is very important for having a robust sustainable manufacturing concept.

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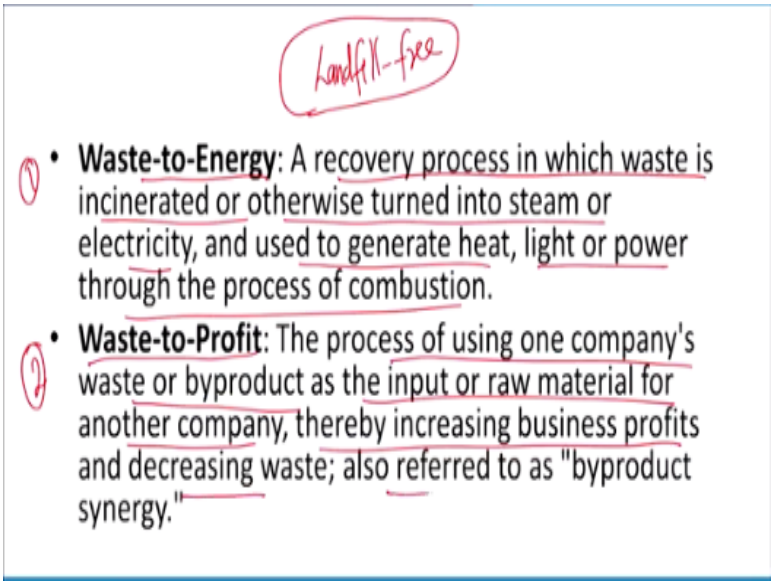

Then, another important thing with respect to sustainable manufacturing is; we need to have some kind of understanding that waste also has some value, when we understand that waste has some value, then only you can find a proper solution of this kind of sustainable manufacturing, so 2 things are again becoming popular in these discussions; one is waste to energy that how you can use, if you recall our discussion when we discuss that land fill free, we can have one use of our waste that is you can generate energy from the waste.

So, a recovery process in which waste is incinerated or otherwise turned into a steam or electricity and used to generate heat, light or power through the process of combustion, so when by following some kind of chemical processes, you are able to use the waste for getting some kind of energy whether it is electricity or other kind of power, steam, whatever the form of that energy may be.

But it is in conjunction with sustainable manufacturing because it is almost impossible to have a waste free manufacturing, some waste will obviously be there but how to use that waste that is need to be discussed and the another thing is waste to profit. If you add value to waste automatically, that waste is not a waste, then you cannot say it is a waste because it is offering some value.

So, as long as it is having no value it is a waste, so we need to also go to this concept that we need to convert waste to value so that it becomes a revenue activity, the process of using one company's waste or by product as the input or raw material for another company, so that you can think of that output of this company is a input to other company for an example, if you go to a rice mill, so in the rice mill, when a rice milling is done; paddy milling is done, you get rice and then you also get lot of husks.

Now that husk is the output or that is the waste for the rice miller but that is input for those organisations which are generating their power plants using that husk, those companies which are making oil out of that husk, for them also, it is an input, so that is the concept of waste to profit so, waste of one company; by product of one company is acting as input or some kind of raw material for another company.

So that is going to increasing profit at decreasing waste and it is also known as the by-product synergy so, it becomes a kind of you can say, a very sustainable business model that output of one or you can say by-product or waste of one is input for other and therefore, you can develop a good cluster, so that the cluster becomes a sustainable cluster, a sustainable manufacturing cluster and that we; you will be able to develop the competitiveness not only for a particular company but for the entire cluster.

So, with this we understood various important terms which are used in discussions of sustainable manufacturing with this, we come to end of this discussion, thank you very much.